APPENDIX C – HABITAT FRAGMENTATION

HABITAT FRAGMENTATION AS A RESULT OF FIRE SUPPRESSION IMPLICATIONS FOR WILDLAND FIRE MANAGEMENT ON THE IDAHO NATIONAL ENGINEERING AND ENVIRONMENTAL LABORATORY

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FIRE SUPPRESSION USING FIRE LINES

This discussion focuses on the ecological impacts of fire suppression using fire lines on the Idaho National Engineering and Environmental Laboratory (INEEL). The widths of many fire lines are equivalent to roads and for this analyses roads and fire lines will be considered interchangeably.

Some suppression activities leave scars on the landscape that can take longer to heal than the direct effects of fire. Yet, at times, mechanical equipment may be necessary to control a fire and protect life and property. Fire management plans should state when, where, and under what conditions different types of mechanized equipment may be utilized. Fire line construction can have long-term impacts on resources. Minimizing the effect and mitigation following fires are important and necessary parts of the suppression action (Council of the Society of American Foresters 1997).

Burning creates gaps in vegetation, as does bulldozing, but it is possible that soil disturbance created by bulldozer trails is the limiting factor required for the promotion and germination of certain exotic species[1]. The construction of bulldozer fire lines leads to severe fragmentation of native habitat (see discussion below) and compaction of soil; providing increased avenues for weed transport and increased edge effects (Caling and Adams 1999).

Soil degradation may occur as a result of soil compaction. Soil compaction may have a serious negative impact on soil structure and vegetation recovery, which in turn, may impact the ecosystem as a whole. Environmental disruption by soil compaction is a long-term event; as the recovery of compacted sandy soils (sandy soils are more susceptible, and recover more slowly than clay or wetter soils), which are common on the Idaho National Engineering Laboratory (Olson et al. 1995), is extremely slow and can take longer than 50 years (Caling and Adams 1999). Weed invasion of disturbed areas has been linked to changes in soil properties (Zink et al. 1995).

Fire management must include pre-fire planning, planning for management during wildfire, and post-fire planning that includes rehabilitation (Caling and Adams 1999). Continuing the current management practices of suppressing all wildland fires will eventually result in increased areas of old, decadent stands in the sagebrush-grass (*Artemisia sp.*) community that provides conditions for more high-intensity fires that are harder to manage and control (Bureau of Land Management 2001).

Habitat Fragmentation

This is a review of the potential impacts of habitat fragmentation caused by fire and fire suppression, particularly fire lines and roads. Roads and fire lines fragment plant and animal populations (Noss

[1] Increased edges can result in microclimatic changes in light, temperature, wind, humidity, and incidence of fire. Each of these effects can have a significant impact upon the number and kind of species associated with the edge.

2001). Much of the available literature discusses fragmentation of forest ecosystems. However, it is plausible that many of the ecological principles from forest fragmentation are applicable to rangeland fragmentation. The improper management and control of rangeland fires can therefore increase habitat fragmentation and exacerbate the associated impacts.

Habitat fragmentation is the process whereby a large, continuous area of habitat is both reduced in area and divided into two or more fragments (Wilcove et al. 1996; Schonewald-Cox and Buechner 1992; Reed et al. 1996; Theobald 1998). Fragmentation can occur when area is reduced to only a minor degree if the original habitat is divided by roads, canals, fire lanes, or other barriers to free movement of species (Primack 1998).

Habitat fragmentation leads to increasing edge effects, loss of species diversity, alterations in natural disturbance regimes, and alterations in ecosystem functioning (Caling and Adams 1999). Habitat fragments differ from original habitat in two important ways: 1) fragments have a greater amount of edge for the area of habitat, and 2) the center of each fragment is closer to the edge (Primack 1998).

Changes in the microenvironment at the fragment edge can result from habitat fragmentation. Some of the more important edge effects include microclimate changes in light, temperature, wind, humidity, decreased soil moisture, and incidence of fire (Shelhas and Greenberg 1996; Laurance and Bierregaard 1997; Reed et al. 1996). Each of these edge effects can have a significant impact upon the vitality and composition of species in the fragment and increased wind, lower humidity, and higher temperatures make fires more likely (Primack 1998). Edges produced by roads and fire lines can also increase nest parasitism by brown-headed cowbirds (*Molothrus ater*). Brown-headed cowbirds, the only obligate brood parasite in North America, feed primarily in open areas, but use perches to watch for nest building activities. Edge habitats are perfect for their needs (Brittingham and Temple 1983) and brood parasitism increases on edges and in fragmented habitats (Belthoff and Rideout 2000).

Fragmentation affects animal populations in a variety of ways, including decreased species diversity and lower densities of some species in the resulting smaller patches (Reed et al. 1996). Some species of animals refuse to cross barriers as wide as a road. For these species, a road or fire line effectively cuts the population in half. A network of roads or fire lines fragments the population even further (Noss 2001). In addition to direct loss of shrub habitats, responses of shrub-obligate species of wildlife will be related to dispersal capabilities and populations my not persist in landscapes of increasingly fragmented patches of sagebrush after disturbance (Braun et al. 1976; Knick and Rotenberry 1995; Knick and Dyer 1997).

For example, fragmentation of sagebrush communities poses a threat to populations of pygmy rabbits (*Brachylagus idahoensis*) because dispersal potential is limited (Weiss and Verts 1984). Gates (1983) found that although some pygmy rabbits dispersed from a fire, predators killed most. Sage grouse (*Centrocercus urophasianus),* sagebrush obligates, are totally dependent on sagebrush habitat (Benson et al. 1991) and removal of sagebrush has a negative impact on the value for winter habitat (Gates 1983). Good winter range provides sage grouse with access to sagebrush under all snow conditions. Sage grouse only eat sagebrush during the winter and often use relatively open habitats with 10-25% sagebrush canopy cover and an average height of 25-35 cm above the snow.

The quality and quantity of breeding and winter habitat have declined during the 1980's and 1990's because of prolonged drought, fires and agricultural development. Vast areas that were once sagebrush/bunchgrass habitats are now dominated by cheatgrass (*Bromus tectorum*), with little or no sagebrush over story, making population recovery difficult.

Many sage grouse populations are migratory and birds may move 100 km or more between seasonal ranges. Sage grouse have a relatively low reproductive rate compared to other game bird species so populations do not recover very fast following optimal conditions (Schroeder 1999).

Roads fragment plant populations and facilitate the spread of invasive animals, insects and plants. Many of the weedy plants that dominate and disperse along roadsides are exotics. In some cases, these species, such as cheatgrass, spread from roadsides into adjacent native communities (Noss 2001). Exotic species disrupt natural ecosystem processes and the species that depend on them. Exotic plants have been shown to replace native under story vegetation, inhibit seed regeneration, and change soils nutrient cycling. Some weeds can cause higher erosion rates or change fire regimes.

In shrub-steppe ecosystems, invading weeds, which were usually non-mycorrhizal, disrupted succession of native species, 99% of which were mycorrhizal –dependent. Also, fires have become more common and extensive in sagebrush ecosystems invaded by cheatgrass (Natural Resources Defense Council 2001). Presence of cheatgrass along edges (fire lines and roads) may allow it to invade burned patches, increasing the likelihood of fire spread into adjacent sagebrush patches, further fragmenting the ecosystem (Knick and Rotenberry 1997).

Disturbances such as fire and roads can increase the distance between remaining shrub patches that provide seed sources (Knick and Rotenberry 1997). The dominant shrub on the INEEL, big sagebrush (*A. tridentata)*, does not re-sprout from crown or roots following fire (Young and Evans 1978). Thus, natural regeneration of these shrub lands could be severely limited by availability and dispersion of seed sources. Dispersal of sagebrush is primarily wind driven and occurs largely within 30 m of the seed source (Young and Evans 1989).

Studies concerning roads and their influence on habitat fragmentation offer sufficient reason for adopting a precautionary stance toward road issues (Brittingham and Temple 1983). Roads (fire lines) precipitate fragmentation by dissecting previously large habitats into smaller ones. As the density of roads in landscapes increases**,** these effects increase as well. Even though roads occupy a small fraction of the landscape in terms of land area, their influence extends far beyond their immediate boundaries (Reed et al. 1996).

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